ERRORS IN MEDICATION DOSAGE IN THE URGENCY UNIT OF A HOSPITAL ERROS DE DOSE DE MEDICAMENTO EM UNIDADE DE URGÊNCIA HOSPITALAR ERRORES DE DOSIS DE MEDICAMENTO EN UNA UNIDAD DE URGENCIA HOSPITALARIA

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ABSTRACT

Objective: to analyze intravenous medication dosage errors in a hospital emergency service. **Method:** this is a quantitative, cross-sectional study involving 139 drug doses. Data were collected through non-participant observation with aid of a form. The data were analyzed and interpreted through descriptive statistics and the chi-square test. **Results:** the pharmacological class showed that analgesics presented the highest frequency (38.1%), followed by vitamins (33.8%) and antibiotics/antimicrobials (17.3%). It was also verified that out of 118 medications that required dilution, no error occurred in 88; and 62 (70.5%) were performed by nursing students. It is noteworthy that in the 30 medication administrations in which errors occurred, 70.0% were made by nursing students and 30.0% by nursing technicians. Infusions were interrupted before completion in 64 cases (90.1%). **Conclusion:** a high frequency of dosage errors was observed, reiterating the need for constantly checking the flaws in the medication system and in the work process of the health team. It is projected that studies of this type may subsidize institutional policies for safety regarding the use of medicines. **Descriptors:** Medication Errors; Patient Safety; Hospital Units; Use of Medications; Ambulatory Care; Medical Errors.

RESUMO

Objetivo: analisar erros de dose de medicamentos endovenosos em um serviço de pronto-atendimento hospitalar. **Método:** trata-se de estudo quantitativo, transversal, envolvendo 139 doses de medicamentos. Coletaram-se os dados mediante observação não participante com um instrumento do tipo formulário. Realizou-se a análise e interpretação dos dados por meio da estatística descritiva e teste qui-quadrado. **Resultados:** evidenciou-se, quanto à classe farmacológica, que os analgésicos apresentaram a maior frequência (38,1%), seguidos por vitamínicos (33,8%) e antibióticos/antimicrobianos (17,3%). Verificou-se, ainda, que dentre 118 medicações que necessitaram de diluição, em 88 não ocorreu erro, sendo que 62 (70,5%) foram realizadas por acadêmicos de enfermagem. Sobressalta-se que nas 30 que tiveram erro, 70,0% foram efetuadas pelos acadêmicos de enfermagem e 30,0% pelos técnicos de enfermagem. Interrompeu-se em 64 (90,1%) a infusão ainda incompleta. **Conclusão:** observou-se alta frequência dos erros de dose, reiterando-se a necessidade de verificação constante das deficiências no sistema de medicação e no processo de trabalho da equipe de saúde. Projeta-se que estudos desse perfil poderão subsidiar políticas institucionais para segurança quanto ao uso dos medicamentos. **Descritores:** Erros de Medicação; Segurança do Paciente; Unidades Hospitalares; Uso de Medicamentos; Assistência Ambulatorial; Erros Médicos.

RESUMEN

Objetivo: analizar errores de dosis de medicamentos endovenosos en un servicio de pronta atención hospitalaria. **Método:** se trata de un estudio cuantitativo, transversal, involucrando 139 dosis de medicamentos. Se recolectaron los datos mediante observación no participante con un instrumento del tipo formulario. Se realizó el análisis e interpretación de los datos por medio de la estadística descriptiva y la prueba de chi-cuadrado. **Resultados:** se evidenció, en cuanto a la clase farmacológica, que los analgésicos presentaron la mayor frecuencia (38,1%), seguidos por vitaminas (33,8%) y antibióticos/antimicrobianos (17,3%). Se verificó, además, que entre 118 medicamentos que necesitaban de dilución, en 88 no ocurrió error, siendo que 62 (70,5%) fueron realizadas por académicos de enfermería. Se destaca que en las 30 que tuvieron error, el 70,0% fueron efectuadas por los académicos de enfermería y el 30,0% por los técnicos de enfermería. Se interrumpió en 64 (90,1%) la infusión aún incompleta. **Conclusión:** se observó una alta frecuencia de los errores de dosis, reiterándose la necesidad de verificación constante de las deficiencias en el sistema de medicación y en el proceso de trabajo del equipo de salud. Se proyecta que estudios de ese perfil podrán dar soporte a políticas institucionales para seguridad acerca del uso de los medicamentos. **Descriptores:** Errores de Medicación; Seguridad del Paciente; Unidades Hospitalarias; Utilización de Medicamentos; Atención Ambulatoria; Errores Médicos.

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INTRODUCTION

It is known that the practice of drug therapy has been growing exponentially throughout the world due to great advances in the pharmaceutical industry with the evolution of knowledge of the active principles and the various forms of medicalization that cover all aspects of the health-disease process. It is demonstrated, on the other hand, that errors associated with the use of medicines have had a significant prominence in the scientific community because they occur with certain frequency and bring several complications to patients.¹

A medication error is defined as any avoidable event that can bring complications to patients, and when such errors do not cause damages, their occurrence indicates a low level of safety in health care. This type of event is related to professional practice, procedures, or systems, ranging from prescription failures to medication use.²

Medication errors include dosage errors, which are nonconformities between the prescribed and the administered dose. According to an analysis carried out in two tertiary hospitals in Brazil, dosage errors are the most common, happening in average of 28% of cases.³

It is also worth noting that in the intravenous administration of a drug, the entire dose reaches the systemic circulation with total bioavailability of the active principle. This calls attention to the need for the doses to be properly respected to make each prescribed and administered drug achieve systemic availability. It is noteworthy that doses and volumes of diluents that differ from what the indicated in prescriptions can also influence the form of preparation and administration and consequently generate therapeutic failure and drug resistance.⁴

According to the World Health Organization (WHO), it is speculated that 25-70% of health spending in developing countries is directed to medicines, and hospitals spend an average of 15% to 20% of their budget to deal with problems caused by improper use of medications. In view of the frequency of these events, the collection of detailed information on Adverse Drug Events (ADE) is encouraged, in order to analyze them for the purpose of planning and adopting strategies to reduce these incidents to the maximum.⁴

It is noteworthy that in hospital care, both in the clinical and urgency area, the nursing team plays a fundamental role in the prevention of these errors. Nursing workers are professionals who are responsible for the processes of preparing and administering drugs, that is, they are in the last step of the medication system. Thus, this fact increases the responsibility of the nursing team, because some tasks such as calculation for exact

dose measurement, dose checking, and surveillance of volumes discarded at the end of infusions are the duty of nursing professionals.⁵

It is therefore considered that the identification of medication dose errors is of great importance, and identifying the factors causing these inaccuracies, based on the frequencies found, is essential to create strategies for reducing them, so as to increase the quality of care and promote greater patient safety.

OBJECTIVE

- To analyze dosage errors of intravenous drugs in the urgency department of a hospital.

METHOD

This is a cross-sectional quantitative study carried out during 2017 in a medium-sized hospital located in the municipality of Picos in the Northeastern region of Brazil, which covers 43 municipalities and functions as a field of practice for the health courses of higher and technical-vocational institutions, and offers care in the following specialties: emergency, medical clinic, surgical clinic, pediatrics, obstetrics, intensive care, and general surgeries.

The adult urgency department was chosen as the site of the present research, specifically the medication rooms and the male and female observation rooms, because the patients receive the prescribed drug therapy in these places of the sector.

It was noted the need to know the number of medications made available to the urgency service in the previous month for selection of the amount of doses that would be analyzed. The amount of medications sent for the sector in the previous month was thus requested to the pharmacy service of the institution, obtaining a value of 3,726 doses.

Considering the operability of the object of study, it was decided to include only drugs that were administered intravenously, because the measurement of lost volumes and dose errors would be more easily measured. Thus, the calculation for finite populations was applied, where: $Z = 80\%$; $P = 50\%$; $Q = 50\%$; $N = 3,726$, and $E = 5\%$.

The sample consisted of 157 doses, but only 139 were used in the study. The first 18 samples were excluded because it was concluded that the presence of the researcher could interfere in the habitual behavior of the team. These sample losses happened during the pre-simulation of data collection with the instrument to circumvent the Hawthorne effect, which refers to the probable change of behavior when such behavior is of special interest.

Only doses in which the drug was administered in solutions of more than 50 ml were included in

the study because there was the possibility of checking volumetric losses by interrupting the infusion or by intravenous administration. Doses administered through flash infusion and volumes of less than 50 ml were excluded.

Non-participant observation was made on days chosen through random selection, totaling 32 visits. In these visits, a form was used as instrument for data collection. The items to be observed were: characteristics of the reconstitution, dilution, and errors associated with these steps. It should be noted that when there were volumetric losses at the end of the infusion, they were placed in a graduated cup and with a syringe graduated from 1 to 20 ml, for measuring the leftover solution in the infusion device and bags removed from the patient. It was requested that the person responsible for the administration did not put the devices used for infusion in the trash until the researcher measured the leftover medicines.

It turned out that after surveying the statistics of the most used medicines, a request was made to the pharmacy of the list of unit prices of these

medicines to obtain an estimate of cost of wasted drugs.

Data were cataloged in the IBM-Statistics Statistics Package Social Sciences (SPSS) version 20.0 for Windows. Descriptive statistical operations were then performed for the presentation of relative and absolute frequencies, in addition to calculation of measures of central tendency and dispersion. Analytical statistics included the chi-square test to find the association between presence of absence of error during dilution of medicines and the person who performed the procedure.

During the study, formal requirements of national and international standards of research involving human subjects were respected. The study was approved by the Human Research Ethics Committee of the Federal University of Ceará under number 237,393.

RESULTS

First, the most frequently used medicines and the pharmaceutical forms prescribed are presented, as shown in Table 1.

Table 1. Pharmacological class and pharmaceutical form of medicines. Picos (PI), Brazil, 2017.		
Variables	n	%
Pharmacological class		
Analgesic	53	38.1%
Vitamin	47	33.8%
Antibiotic/antimicrobial	24	17.3%
Anticoagulant	11	7.9%
Anticonvulsant	2	1.5%
Antiemetic	1	0.7%
Gastric protector	1	0.7%
Pharmaceutical form		
Vial/ampoule	114	82.0%
Bag with closed system	21	15.1%
Ampoule	4	2.9%

The analgesics were the most frequent (53 cases, 38.1%), followed by vitamins (47, 33.8%), antibiotics/antimicrobials (24, 17.3%), and anticoagulants (11, 7.9%). As for intravenous medication, the most frequent pharmaceutical form was vial/ampoule (114, 82.0%).

It is noteworthy that some medicines were diluted for compatibility with intravenous infusion, being saline solution the most used (114, 96.6%). It was found that in most cases, the saline solution used for dilution was in 100 ml bags (78, 56.1%) or 500 ml bags (53, 38.1%).

Table 2. Association between presence and absence of error during dilution and the professional who performed the procedure. Picos (PI), Brazil, 2017.				
Drug errors	dilution	Professional who made the dilution		Total
		Nursing student		
		n	%	
		n	%	
No		26 (29.5%)	62 (70.5%)	88
		9 (30.0%)	21 (70.0%)	
Yes				30
Statistics		X ² * = 0.002; 1 df*; p = 0.962		

* Chi-square test; df = Degree of freedom.

It was observed that no error occurred in 88 of the 118 medications that required dilution, and 62 (70.5%) were performed by nursing students (Table 2). In the 30 cases where an error happened, 21 (70.0%) were made by nursing students and 9 (30.0%) by nursing technicians. All the activities carried out by nursing academics were supervised by professors and professionals of the institution. A statistically significant relationship should not be attributed in the crossing of dosage error with

the preparation performed by nursing students because, according to Table 2, most medications were performed by this group, thus preventing the comparison with the other group.

No statistical association was found between the occurrence of errors and the professionals who performed the action ($p = 0.962$), leading to the conclusion that errors occurred regardless of who performed the dilution.

Table 3. Association between the variables (removal of the medication before its complete infusion, reason for removal, pharmacological class) with the volume of medicine wasted. Picos (PI), Brazil, 2017.

Variables	n	%	Volume of medicine wasted in			
			ml	Mean	SD	Median
Removal of the medication before its complete infusion						
Yes	71	(51.1%)	11.9		9.4	10.0
No	68	(48.9%)	-		-	-
Reason for removal (n = 71)						
The rofessional or academic interrupted the infusion before its completion	64	(90.1%)*	10.0		6.7	9.0
Medicine replacement due to worsening in the clinical condition of the patient	1	(1.4%*)	45.0		-	45.0
Medical request	6	(8.5%*)	26.6		11.7	23.5
Pharmacological class (n = 71)						
Analgesic	33	(46.4%*)	6.0		4.4	4.5
Vitamin	18	(25.3%*)	17.0		10.8	15.0
Antibiotic/antimicrobial	12	(16.9%*)	7.1		3.9	7.5
Anticoagulant	8	(11.2%*)	11.2		5.5	10.5

SD: Standard Deviation

*Percentages calculated considering n = 71 (removal of medication before complete infusion).

Table 3 shows that 71 (51.1%) of the medications were suspended before complete infusion, where in most cases the professional or academics interrupted the infusion before completion (64, 90.1%).

It was also verified that analgesics corresponded to the most frequent pharmacological class (33, 46.4%). As the study site is an urgency unit, prescriptions for pain relief are quite common. It should be noted, however, that antibiotics/antimicrobials were present with a frequency of 12 (16.9%) of the prescriptions. This also deserves extreme attention in the research, because when the whole prescribed dosage is not administered, there is a considerable risk of inefficacy of treatment, and inducement of resistance in the patients' bodies.

DISCUSSION

The data from this research are in line with those of other studies, in the sense that the incorrect administration of medicines contributes to a greater probability of hospital stay, generating instability in the whole care process.^{6,7} In the case of an urgency department, care must be absolutely safe because the majority of patients admitted have a serious health condition.⁸

Considering the research site, analgesics are the pharmacological class that presents higher frequency of administration, since most patients present pain as the main complaint during the consultation.⁹

It is also known that dilution errors were frequent and preceded by errors in the timing of administration.¹⁰ This research showed that most of the errors related to dilution of drugs were made by nursing academics. However, it is emphasized that most of the dilutions were performed by this group and, therefore, this factor contributed to the high percentage.

The on-site analysis showed several principles that cause errors during drug preparation and administration, particularly overcrowding in the unit and lack of inputs such as insufficient saline solution. It is reiterated that several studies have pointed to factors responsible for errors during the process, including lack of knowledge about medicines by professionals and outdatedness regarding active principles; lack of control and standardization of procedures in the preparation; similar names and packaging colors of medicinal products; lack of alerts in the system to signal the occurrence of errors; and a poorly organized environment.¹¹⁻¹³

It was noted during the data collection that all prescriptions were checked before administration

of the medicines. This attitude on the part of the team agrees with the literature, which emphasizes the importance of checking the characteristics in the prescription before carrying out any administration.^{14,15}

In addition, other behaviors that should be adopted include: checking the medicine at the moment when it arrives from the pharmacy sector; avoiding parallel conversations during preparation; respecting the established schedules; preparing medications in an appropriate place; identifying the medications prepared; and reporting the reason for not administering them.^{16,17}

It was found that in some cases the medicine diluted in the saline solution was discarded in the sink of the medication room when the air was removed from the device. It is stressed that this practice can lead to environmental imbalances, taking into account that when medicines are subjected to varying humidity, temperature and light, they can become toxic. Analgesics are composed by chemicals that can alter the circadian cycle of irrational animals and humans which use water or food contaminated by these medicines, not to mention antibiotics that can cause bacterial resistance in the long term when exposed to the environment.¹⁸

It was identified that the interrupted infusion of medicines culminated in the fact that patients always received a smaller dose than that indicated in the prescription. This is explained by the observation of the following situation: the patient would clamp the infusion device by his own decision and go to the medication room to request the withdrawal of the medication, and the patient was not instructed to wait until the infusion was completed, although there was a small amount of solution left.

It should be pointed out that this infusion of slightly lower doses affects the safety and efficacy of the treatment, since the use of drugs in this way is related to therapeutic failure, especially when it comes to antimicrobials, due to bacterial resistance.¹⁹ It is also noteworthy that when the medication is administered in incorrect doses, it generates a loss of financial and material resources for the hospital. From this perspective, wastes of the drug ciprofloxacin were calculated and it was found that, in one year, approximately R\$ 245.70 were spent in dosage errors.

It was observed that during dilution, 250 ml saline solutions were discarded until reaching a volume of 100 ml so as to prepare the medication according to the medical prescription. However, this method contributes to a greater spending than necessary, causing a loss of material and resources of the institution.

A similar study investigated the waste of bortezomib associated with the treatment of multiple myeloma and found that about 40% of the

total volume of bortezomib used was wasted, and that the adequacy of the volumes of bottles available in the market would cause savings of around 40-60% in the costs associated with use.²⁰

Some limitations of the research are: impossibility of accurately quantifying the surplus volume of some drugs, due to previous dilution of the active principle in saline or glycoside; collection of data only during daytime; and absence of evaluation of environmental factors such as local lighting, which may compromise the professional's ability to see the product.

It is emphasized, however, that despite these limitations, the study contributes to highlight the problems related to the inaccurate dosage of antimicrobials prescribed in an emergency sector, and to alert about the direct financial waste caused by this type of event.

CONCLUSION

The study led to the conclusion that there was a greater frequency of dosage errors, interruption of infusions before completion, analgesics available in the pharmaceutical form of vial-ampoule, and saline solution was the most used diluent for the preparation of the medications. There was no statistically significant association between the occurrence of errors during dilution and the person who performed the procedure.

It is emphasized, therefore, that the data evidenced in the research point to the need for some measures that may generate contributions for health care, such as: continuing education to the professional staff about adequate conducts during the use of medications, especially in performing calculations and measuring doses accurately; minimizing the presence of external factors that could disrupt the procedures, such as unnecessary noise in the environment and bulky traffic of other people in the place; and greater vigilance regarding the volumes despised at the end of the infusions.

It is expected that the present study provide supporting data for further research with similar methodologies to be carried out in other health institutions, in order to compare the results and to support the construction of educational interventions that may intervene in the factors that cause these errors.

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